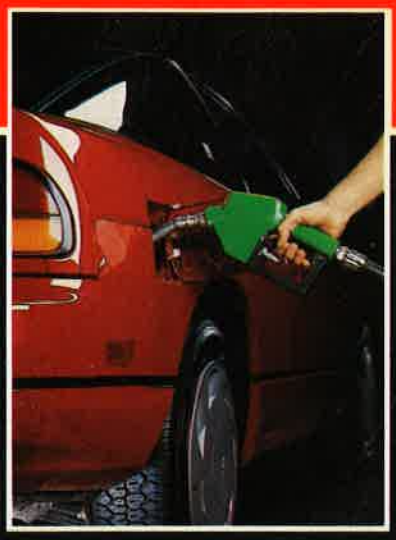
JANUARY 1990

GASOLINES: BEST BRANDS FOR YOUR CAR



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Consumer Reports

FIT TO DRINK?

How you can find out. What you can do.

Tests: Filters, softeners, distillers, reverse-osmosis systems, water labs

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FIT TO DRINK?

People selling water filters and the like hope you won't have the answer to that question. The less you know about what might be lurking in your water, the easier it is for them to sell you equipment you may not need for a problem you may not have. How can you find out if your water is fit to drink? If it's not, what's the best way to clean it up? This special section provides the answers. On page 30, we explain which pollutants are most worrisome and where you can go for reliable tests. If you do need to treat your water, the Ratings reports that begin on page 33 will help you choose the most effective equipment. Meanwhile, avoid the hard sell; the report below tells you how.

CREATING A MARKET: THE SELLING OF WATER SAFETY

Companies in the water-treatment business could sell their hardware on its merits. Unfortunately, many companies have chosen instead to prey on the widespread fear that the water isn't safe to drink.

"HELP SAFEGUARD YOUR FUTURE AND YOUR HEALTH," proclaims the headline on a glossy brochure for the *Technetic* reverse-osmosis "drinking water system." The system, says the brochure, "effectively reduces or removes contaminants found in many home water supplies, including sodium, lead, aluminum. . . .*all of which may affect your health as well as the taste of your water.*"

Hard-to-Find Health Products, an outfit in Charlottesville, Va., begins its brochure for the *Rainmaker 3* distiller this way: "The water in this country is getting so bad, it's disgusting. . . .Well, with the water THIS bad, only the Rainmaker is going to do the job. . . .The sooner you order one, the sooner you'll be drinking the PUREST water you ever tasted in your life."

Even Culligan, a company synonymous with water softeners, adds this pitch: "We understand that a water improvement system is an investment in your family's well-being."

The home water-treatment business is still in its infancy, but it has attracted some 400 manufacturers, and sales are expected to top $1-billion a year by 1995. To move the merchandise, water-treatment sellers have to convince people that they have a problem. Some water is polluted (see page 30), but most people don't have a problem with their drinking water, though they may not know that. So the sales pitches prey on fear or ignorance. The result: Many people buy equipment they don't need to cure a problem that never existed.

The Better Business Bureau says that inquiries about water-purification offers jumped 40 percent from 1987 to 1988. Inquiries don't necessarily equal ripoffs, but the BBB says many consumers have been stung. Merchandise doesn't do what was claimed, requests for refunds are not honored, and consumers are unable to reach companies to get service.

Granted, plenty of responsible businesses and salespeople are in the water-treatment business, offering products that live up to their advertising claims. Water softeners, for example, have been sold for years as a solution to scaly rings in the bathtub, deposits in the water heater, and anemic suds in the dishwater—and generally without exaggerated health claims. And any number of dealers sell water-treatment devices without resorting to deception. Indeed, when we called several companies listed under "Water Softening & Conditioning Equipment, Service & Supplies" in the Yellow Pages to inquire about a reverse-osmosis filtering system, they all told us they'd sell us one if we wanted it, but that we probably didn't need one if we were getting municipal water.

But the safe-water purveyors aren't always so forthright. For example, a *Culligan* salesman recently contacted a CU staffer to try to sell him a battery of water softeners and such. The staffer listened to a one-hour pitch that included frequent allusions to unhealthy contaminants in the water. At one point, the salesman pulled out a sheaf of newspaper clippings about toxic-waste contamination in the area a few years ago. And he opened up a small kit of glass

The booming water-treatment industry has attracted no fewer than 400 manufacturers.

vials and chemicals to test the staffer's water on the spot. His test showed some sludge in the staffer's water.

The price for the *Culligan* hardware—$3500. The staffer said he'd like to think it over, but the *Culligan* man wanted a decision on the spot. (That can be one sign of a less-than-ethical sales pitch.) He may have feared our staffer would get an independent water test, which the staffer did. Result: The water was fine in every respect.

The door-to-door sell

According to the consumer-protection officials and victimized homeowners we talked with across the country, the *Culligan* man's sales pitch followed a common pattern. Some door-to-door sellers also try tactics like these:

The phony survey. The salesperson claims to be taking a survey of water quality in the area. A Long Island, N.Y., couple we talked with were subjected to such a "survey." They said they assumed the salesman represented a government agency.

The sludge test. Once inside, the salesperson asks the homeowner to run some tap water into a bottle. The salesperson adds a few drops of an unnamed chemical—probably a flocculating agent, which combines with dissolved minerals and causes them to precipitate out of the water. A sludgelike residue forms at the bottom of the bottle. The homeowner is surprised. The salesperson looks concerned—but fails to mention that the chemical visually exaggerates the amount of minerals, and that the minerals are probably not harmful.

The washcloth test. The homeowner is asked to get a clean washcloth. The salesperson produces a container of "treated" water and stuffs in the washcloth. Presto. Detergent dissolves out of the washcloth and forms a layer of suds on the surface of the water. The point of the hocus-pocus is to show how the homeowner's "raw, untreated" water keeps the laundry from getting clean. In fact, it's normal for garments to retain some detergent when washed in unsoftened water. The detergent is harmless, and the test is meaningless. Further, "raw, untreated water" is a complete mischaracterization for the 83 percent of the population served by a municipal water company.

The charts. The salesperson produces charts that show how the devices being sold remove 99 percent of various contaminants. That may be true—when the unit is new, under ideal conditions, or if the unit is scrupulously maintained by the owner. But the salesperson will probably not mention that most of the "contaminants" are rarely found in drinking water.

Bottles on the doorstep. Someone leaves a small bottle at the front door, with an official-looking note asking you to fill the bottle with tap water so it can be tested. The results are always the same: The water is "dangerously contaminated" and should be treated with the company's product.

'Good news' calls and cards

The same tactics used to sell resort time-shares and vacation airfare packages are now being used to unload water-treatment hardware.

You receive a congratulatory postcard; you've been selected to receive one of five awards in return for calling to participate in a national promotion. The nature of the promotion is often not stated on the card. The prizes include such items as a car, $5000 in cash, 100 shares of stock in a large company, a vacation for two in Mexico, and a pair of "Georgio Casini" diamond watches. Some outfits using the prize promotions dispense with the postcard and call you directly.

Once the company has you on the line, you'll hear a carefully scripted sales spiel like this one from a company known as American West Health Products:

"You have been selected this year as a major credit card holder to receive one of five major awards worth up to thousands of dollars for participating in our nationwide pure water promotion. . . . I'm sure you are aware of the shocking deterioration of our nation's water supply, right?"

The caller goes on to rhapsodize about the awards that await and gives a few details about the water-treatment device. "We here at American West represent an appliance called an Activated Carbon water purification system. It's a regular kitchen appliance which is specifically designed to remove virtually all the chlorine and man made chemicals in your tap water.

"What we would ask you to do when you receive the unit," the caller continues, "is two quick tests. First, do a before and after taste test. Second, do a before and after test on your ice cubes. We know you will be shocked at the difference. And that is when you will realize just how important pure water really is!"

The price for this unit is $598—double or triple the cost of the best carbon filter rated on page 35. But then, the American West filter "includes the award, from the '89 Buick down to the $5,500 in cash. . . . "

According to the Better Business Bureau, people will most likely be "awarded" a piece of costume jewelry worth a few dollars or a "vacation" for two that doesn't include airfare, meals, or other necessities.

Avoiding the oversell

Your guard should go up if someone tries to sell you a water-treatment device you didn't know you needed. Have your water tested yourself (see page 32) to find out if there's a problem that needs to be corrected.

Other signals for caution: a salesperson who implies he or she is from the government; a salesperson who asks for your credit-card number (unless you're familiar with the company); a salesperson who implies that you need this device to protect your family.

Before doing business with any company you don't know, call your local Better Business Bureau or consumer-protection agency to find out if there are unresolved complaints against it.

If you have complaints yourself, you can report them to your local Better Business Bureau and to the Federal Trade Commission (Washington, D.C. 20580). You can get information about water treatment from the Water Quality Association, a trade group, at 4151 Naperville Rd., Lisle, Ill. 60532.

Of course, some water does need treatment. In the following pages, we'll discuss home-treatment devices and explain what each can do. ■

THE NSA STORY

TOO MUCH FOR TOO LITTLE

One of the most visible companies in the water-treatment business is Memphis-based National Safety Associates. The company claims to have sold two million water filters, marketing them through a multilevel dealer network. CU's efforts to talk with company representatives were unsuccessful, but through the company's printed and video materials, interviews with former NSA dealers, and information from Government agencies, we were able to get a picture of the way NSA operates.

NSA sells by recruiting dealers, who become direct distributors when they sell $5000 worth of filters in a month. The next level is sales coordinator, followed by national marketing director. At every step, the company offers bonuses for extra sales volume. And at every step, NSA encourages its people to sell to their friends, relatives, and neighbors. Put a filter in a friend's home for a week, suggests NSA. It's the "puppy dog" approach—once someone gets used to having the filter around, it will be impossible to get rid of. Especially if it's being sold by a friend.

The promise of big payoffs tempts many; NSA says it has 20,000 dealers. Dealers are told that with bonuses and promotions, their profit from the company's most popular model, selling for $179, can be more than $100. No wonder NSA can afford to pay generous commissions to its sales force. NSA's training tapes include testimonials from dealers who are making six- and even seven-figure incomes. But some NSA dealers have filed complaints charging that they were misled about the potential earnings and that they had to spend hundreds of dollars for filters they couldn't unload.

The NSA filter that sells for $179, the *50C*, is less effective at removing contaminants than other filters we tested that cost half as much. Whereas most units use inexpensive replaceable cartridges, the NSA filter must be thrown out once it has treated 1000 to 2000 gallons of water.

NSA's activated-carbon filters are claimed to be bacteriostatic. That's true, at least for the *50C*. Nevertheless, in CU's judgment (as well as that of the Environmental Protection Agency), bacteriostasis in a carbon filter is of limited usefulness. Water supplied by municipal systems doesn't contain dangerous levels of bacteria.

Some NSA dealers claim that their devices are "EPA-approved." The EPA doesn't approve or disapprove filters; it merely assigns registration numbers. The only thing implied by EPA registration is that silver, the bacteriostatic agent, isn't released into the water at unsafe levels. Our tests confirmed that fact.

Selling tools Brochures and ads range from slick to simplistic, but the underlying message is the same: You and your family won't be safe unless you buy our product to clean up your water.

THE POLLUTANTS THAT MATTER MOST: LEAD, RADON, NITRATE

Nearly 70 percent of Americans are worried about the quality of their drinking water, according to a recent survey. Much of their concern centers on how water looks, tastes, or smells. Unfortunately, water that is hazardous to your health usually looks, tastes, and smells just fine.

People who draw their water from a well, for example, most often complain of water discolored by iron or manganese. Both metals produce offensive tastes and odors and can stain clothes or household fixtures. But they have no known adverse health effects at levels found in water. On the other hand, lead, another metal common in drinking water, is tasteless, odorless, and colorless—at levels that are toxic.

More than 100 contaminants are now subject to water-safety regulations, but the level of risk each poses and the number of people affected vary widely from one pollutant to another. Accordingly, for this report, CU asked Government officials, environmental groups, and university experts to name the drinking-water pollutants of highest concern, taking two factors into account: the prevalence of the pollutant nationwide and the strength of the evidence indicating it's a health hazard. Not all the experts agreed, but we did achieve a rough consensus.

PCB's, industrial solvents, gasoline, and other man-made pollutants that get the most publicity weren't among the top concerns. They're present at high levels in only a few places; and for most of them, clear evidence of hazard is lacking at the levels usually found in water. Instead, the most worrisome drinking-water pollutants are lead, radon, and nitrate. We'll describe the dangers they pose, where they're likely to occur, and how you can remove them.

MAJOR CONTAMINANTS FOUND IN DRINKING WATER

Contaminant	Type	Main sources	Health effects	Main risk group
Health hazards				
■ *The following contaminants are widely found in water; their threats to health are well-established.*				
Lead	Inorganic chemical; heavy metal	Soft or acidic water in lead pipes, copper pipes connected by lead solder, or brass faucets.	Developmental and learning disabilities, low birth weight.	Children, fetuses.
Radon	Radioactive gas	Groundwater.	Lung cancer.	Anyone.
Nitrate	Inorganic chemical	Wells in agricultural areas.	Methemoglobinemia, a blood disorder.	Infants under 6 mo.
■ *The following contaminants are found in water less often than those listed above, or the seriousness of the hazard from low levels of contamination is unclear.*				
Pesticides	Organic chemicals	Runoff and seepage in agricultural areas.	In high doses, liver, kidney, or nervous-system damage; possibly cancer.	Anyone.
Trichloroethylene	Organic chemical	Industrial effluents or hazardous-waste sites.	In high doses, nervous- system damage, possibly cancer.	Anyone.
Trihalomethanes	Organic chemicals	Chlorination of surface water.	Possibly cancer.	Anyone.
Bacteria, viruses, Giardia	Microorganisms	Insufficiently disinfected or filtered water.	Intestinal and other diseases.	Anyone.
Taste killers				
■ *The following contaminants, in sufficient quantity, may degrade the taste, odor, or appearance of water but are not known to be hazardous to health.*				
Ferrous iron, manganese	Minerals	Groundwater.	—	—
Hardness minerals (calcium, magnesium)	Minerals	Many water sources, especially groundwater.	—	—
Chlorine	Water-treatment chemical	Excessive residue of chlorination	—	—

LEAD

It's been known for decades that lead is highly toxic and often turns up in drinking water. But two recent developments have heightened concern over the metal.

Surveys have found that significant lead levels in drinking water are much more common than had been assumed. And levels once considered safe are now known to threaten health, particularly the health of infants and children. The U. S. Environmental Protection Agency estimated in 1986 that some 40 million Americans were using drinking water containing potentially hazardous levels of lead.

The focus on lead in drinking water stems partly from success at controlling it elsewhere. Our total lead exposure is much lower than it was a decade ago, thanks to bans on lead-based paint, the removal of lead from gasoline, and progress in eliminating lead solder from food cans. These improvements have increased the relative importance of drinking water as a source of lead. The EPA estimates that drinking water now accounts for 15 to 25 percent of a child's total lead intake—and much more if the water is highly contaminated.

Acute lead poisoning can cause severe brain damage and even death. The effects of chronic, low-level exposure, however, are more subtle. The developing nervous systems of fetuses, infants, and children are particularly vulnerable. Recent studies show that lead exposure at a young age can cause permanent learning disabilities and hyperactive behavior.

Pregnant women should be especially concerned about lead in drinking water. Lead not only may impair mental development of fetuses but can also increase the risk of low birth weight. Low-level lead exposure is also associated with elevation in blood pressure, chronic anemia, and peripheral nerve damage.

Very little lead occurs naturally in water. It gets there primarily from corrosion of plumbing that contains lead. There are three main sources:

Service pipes from water mains. Many homes built from about 1910 to 1940 have service pipes made of lead. Newer homes may have lead pipes too, especially in colder regions. (In Chicago, lead pipes were required until 1986, when a nationwide ban on lead pipes took effect.)

Leaded solder in plumbing. Most household plumbing consists of copper pipes connected by solder that is half lead and half tin. Lead-soldered plumbing less than five years old is particularly likely to leach lead into drinking water. A 1986 Federal law banned further use of leaded solder on pipes that carry drinking water.

Brass faucets. Most chrome-plated household faucets are made of brass, which contains from 3 to 8 percent lead.

The severity of lead contamination also depends on the water's chemistry. Soft or acidic water is likely to carry relatively high levels of lead. Such water corrodes plumbing and fixtures, leaching out lead. About 80 percent of public water utilities deliver water that's moderately or highly corrosive, according to EPA criteria.

The EPA has proposed regulations requiring utilities to make their water less corrosive. One technique—adding lime (calcium oxide) to make water less acidic—can greatly reduce lead levels at the tap. It will take several years before the EPA regulations are fully implemented. Meanwhile, reducing lead levels is up to you.

First, have your water tested for lead, especially if your household includes children under six, a pregnant woman, or a woman likely to become pregnant. Mail-order labs (see page 32) charge about $15 for this. Ideally, the level should not exceed five parts per billion.

A few simple steps can reduce levels that are moderately higher—between 10 and 20 parts per billion. These steps are recommended for anyone with that lead level and anyone who's not sure (unless testing shows otherwise, it's prudent to assume that your drinking water contains some lead):

- Use only cold water for all cooking and drinking. Hot water tends to dissolve more lead from pipes. Using cold water is especially important when preparing baby formula.
- Don't drink the first water out of your tap in the morning. Water that sits in the pipes overnight accumulates lead. Flushing the toilet or using the shower can help clear stagnant water from the piping system. When you do use your tap for the first time, let the water run for about a minute, or until it's as cold as possible.
- During the day, let tap water run for a few seconds before drinking. Better yet, keep a pitcher of drinking water in the refrigerator.

A second test of your tap water can tell you if these measures lower lead levels to 10 parts per billion. If not—or if your water initially contained more than 20 parts per billion—you may need to take further action. You should then consider drinking bottled water or installing a treatment device. Reverse-osmosis devices and distillers can be quite effective at lowering lead levels. So can the activated alumina lead-removal cartridge we tested (see page 37).

RADON

Radon poses a greater health risk than any other environmental pollutant. This naturally occurring radioactive gas is a product of uranium and is ubiquitous in the earth's crust. According to EPA estimates, inhaled radon causes between 10,000 and 40,000 lung-cancer deaths each year.

Most of those deaths result from radon that accumulates in houses after seeping up from the earth and entering through holes and cracks in the foundation. But between 100 and 1800 deaths a year are attributed to radon from household water. Showering, dish-washing, and laundering agitate water and release radon into the air. Joseph Cotruvo, director of the criteria and standards division of the EPA's Office of Drinking Water, says that waterborne radon may cause more cancer deaths than all other drinking-water contaminants combined.

The EPA estimates that at least eight million people may have undesirably high radon levels in their water supply. Radon is most likely to be present in water from private wells or from community water systems serving fewer than 500 people. Larger systems usually provide some kind of water treatment that aerates the water and disperses radon gas. (People who get their drinking water from rivers, lakes, or reservoirs have little to worry about. Radon bubbles out before arriving at their faucets.) "Hot spots" for radon in water include New England (especially Maine, New Hampshire, and Connecticut), North Carolina, and Arizona.

Before you test the water for radon, test the air. Our October 1989 report, "Radon: The Problem No One Wants to Face," describes detection devices available. If your indoor radon level is high and you use groundwater, you should then test the water. If the air level is low, don't worry about the water.

Some states have programs that will test water for radon at a modest cost. Commercial laboratories, including mail-order companies, charge between $20 and $35 per sample. Test results are expressed in picocuries of radon per liter of water.

Exactly what level should prompt remedial action is a matter of dispute. According to an EPA official, however, you should definitely take action if the level is 10,000 picocuries per liter or higher. A level of 10,000 picocuries in water is generally estimated to produce 1 picocurie in the indoor air. (At levels below 10,000 picocuries, it's usually more cost-effective to reduce the radon infiltrating from the ground.)

Simple measures may suffice to reduce exposure to waterborne radon. Ventilating your bathroom, laundry, or kitchen may be all that's needed. But water treatment may be necessary if you use a private well. (The EPA will soon propose that public water systems with high radon levels be required to aerate the water before distributing it.)

Removing radon means treating all water entering a house, not just tap water. Granular activated carbon units and home aerators can do that.

A carbon unit for radon removal resembles a water-softener tank and costs about $1500 plus installation. Properly designed and installed, it should reduce waterborne radon levels by 90 percent.

Home aerators haven't been as extensively tested as carbon devices. They cost about $1000 more but seem to remove radon more efficiently. Aeration tanks are often placed in the basement. Pumped-in air agitates the water and causes radon to bubble off. A pipe then vents the gas to the outside.

According to an EPA official, waterborne radon may cause more cancer deaths than all other drinking-water contaminants combined.

NITRATE

Nitrate contamination occurs mainly in groundwater. Most at risk are infants less than six months old, who may become seriously ill from drinking water high in nitrate.

Drinking water generally supplies only about 1 percent of daily nitrate intake; vegetables provide most of the rest. But some water—generally from private wells in rural areas—may contain many times the normal amount.

High nitrate levels usually stem from agricultural activities. Chemical fertilizers and manure from animal feed lots are particularly rich sources of nitrogen compounds, which are converted to nitrate in the soil. The nitrate readily migrates into groundwater. Wastes leaking from septic

The water pollutants that draw the most publicity are not the ones that concern public-health officials most.

tanks also add nitrate to groundwater.

EPA officials say that nitrate pollution in farm areas seems to be worsening. Surveys in the early 1980s found that 3 percent of the rural population—about 600,000 households—used well water that exceeded the EPA nitrate standard of 10 parts per million.

The main threat to infants arises from formula mixed with nitrate-rich water. Bacteria in infants' digestive tracts convert the relatively harmless nitrate to nitrite; the nitrite in turn combines with some of the hemoglobin in the blood to form a compound called methemoglobin, which cannot transport oxygen. The resulting condition, methemoglobinemia, deprives vital organs of oxygen. The ailment is rare, but severe cases can result in brain damage or death. Some adults, including pregnant women, may also be susceptible to developing methemoglobinemia.

Rural families—especially those with infants or pregnant women—should have their wells tested regularly for nitrate. Some state health departments test private wells for free. High nitrate levels may signal that other contaminants—agricultural pesticides or bacteria and viruses from septic tanks—are also present.

Distillers and reverse-osmosis units, discussed on page 36, can remove nitrate. Digging a deeper well to an uncontaminated water source is another alternative.

ORGANIC CHEMICALS

Most pollutants that the EPA regulates are organic chemicals—compounds that contain carbon. While the majority present only localized problems, many public water supplies contain low levels of organic compounds created as byproducts of water chlorination, the chief disinfection measure for preventing waterborne disease.

Health data on trihalomethanes (THMs) and other chlorination byproducts tend to be sketchy or incomplete; but some evidence suggests that, collectively, they may contribute slightly to cancer risk. Public-health officials view the risk as acceptable, however, because of the major disease-prevention benefits of chlorination. Indeed, the EPA does not set limits for THMs in small water-supply systems partly because such systems have experienced disease outbreaks from inadequate chlorination.

The EPA requires water-supply systems serving more than 10,000 people to keep THM levels below 100 parts per billion. If testing shows that your drinking water exceeds that level, you can reduce it significantly with the activated-carbon filters discussed on page 33. ■

HOW TO TEST THE WATERS

Despite possible contaminants, most people have water that's safe to drink. That's particularly true for people served by a large municipal water system. But if you have doubts about the water's quality, here's how you can find out if the water is fit to drink.

Consider the source. If you have municipal water, ask the utility for a copy of its latest water analysis. Federal law requires most public water companies to have the water tested regularly and to make the results available for inspection.

The test results will tell you the condition of the water when it left the reservoir or treatment plant. It won't tell you the condition at the tap—a shortcoming if you're concerned about lead, which generally leaches into the water from the plumbing.

If you draw your water from a private well, call the local public-health department to find out if any groundwater problems exist. If you drink well water, you should have it tested periodically for bacteria, inorganic compounds, and radon. Test for organic chemicals if the well is within a mile or two of a gasoline station or refinery, a chemical plant, a landfill, or a military base. If you live in an agricultural area, have the water tested for nitrate and pesticides.Test for lead if your house is more than 30 years old or if the plumbing pipes are joined with lead solder.

Where to go for tests. Companies that sell water-treatment equipment often offer a free or low-cost water analysis as part of the sales effort. Don't depend on that kind of test: It's like asking a barber if you need a haircut. Consult an independent, state-certified lab instead. You can often find one in the Yellow Pages under "Laboratories—Testing."

Or use a mail-order lab. Our past tests turned up three: *WaterTest* (33 South Commercial St., Manchester, N.H. 03101; telephone 800-426-8378), *National Testing Laboratories* (6151 Wilson Mills Rd., Cleveland 44143; telephone 800-458-3330), and *Suburban Water Testing Laboratories* (4600 Kutztown Rd., Temple, Pa. 19560; telephone 800-433-6595).

The labs send you a kit containing collection bottles and detailed instructions. You collect water samples and ship them back by overnight package delivery. The labs provide test results and an explanation of the numbers two to three weeks later. *WaterTest* charges $30 for a lead test; $75 to test for 24 minerals and bacteria ($110 if you want to check for radon, too); and $195 for a test that includes 109 volatile organic chemicals. Those prices include shipping. *National's* prices start at $29 for a lead test. A 73-item scan for minerals, bacteria, and volatile organics costs $89; and a 93-item test that includes pesticides costs $119. *Suburban* charges $19 for lead, $50 for radon, and $98 to test for 39 items, including bacteria and volatile organics. For *National* and *Suburban*, add $30 to cover shipping.

We recently asked staffers to send water samples spiked with small amounts of lead and chloroform, among other things, to each lab. In the main, the results were reliable. The reports were a little technical, but not too hard to understand. We slightly preferred *National's* report, a detailed letter keyed to the printout of test results. *WaterTest's* report consisted of a printout plus two helpful booklets describing the various contaminants and their ramifications. *Suburban's* report was hardest to decipher.

No single water test is perfect. Over the years, we've found that all labs tend to overstate or understate results occasionally. In the samples we sent recently, for instance, one lab failed to find the added lead; another reported that a sample of unspiked water contained twice as much chloroform as the spiked one.

If a test report says your water has an especially high level of a contaminant like lead, nitrate, or radon, have the water tested by a second lab before taking costly remedial action. ■

CARBON FILTERS: BIGGER IS BETTER

Carbon, usually in the form of granular activated charcoal, can extract many substances from water. The sellers of water-treatment devices tout carbon's versatility, sometimes claiming that a carbon filter can remove everything that mars the quality of drinking water. But a carbon filter can't remove everything. It won't remove microbes, for example. Indeed, under the right conditions, a carbon filter can become a breeding ground for bacteria. Nor should you expect a carbon filter to remove much sediment. The microscopic bits of grit can clog the filter.

Carbon filters work best against organic compounds: chemicals such as pesticide residue or chloroform.

Activated charcoal is honeycombed with a vast network of minuscule channels that account for the material's filtering power. As water passes through the labyrinth, contaminants stick to the walls of the channels. It stands to reason, then, that the more charcoal in the filter, the longer it will last before its effectiveness diminishes.

The typical carbon filter cartridge is about 10 inches high and 3 inches in diameter; that's enough charcoal to treat about 1000 gallons of water. We've termed this type a "high-volume filter." We tested 13 examples, including the *NSA*, a model promoted heavily by door-to-door sellers (see page 28). Some high-volume filters mount under a sink cabinet, others can be set on the countertop. Most dispense filtered water from their own faucet mounted on the sink or countertop.

There are also small filters that fit onto the end of a sink faucet and water pitchers with a small built-in filter. We tested a few of each.

Filters at the tap

We tested the filters using water spiked with chloroform, one of the most common organic compounds found in drinking water. Chloroform, a possible carcinogen, can often be traced to chemical reactions between dissolved organic matter and the chlorine used to disinfect public water supplies. The water we used contained 1 part per million chloroform, 10 times the maximum permitted by the U.S. Environmental Protection Agency.

Carbon filters work best when they're allowed to work slowly. The longer water stays in contact with the carbon, the more contaminants will be trapped within the filter. For that reason, most of the filters we tested come with narrow tubing to restrict the water flow. In our tests, we kept the water flow to between one and two quarts per minute, a stream roughly the diameter of a pencil.

High-volume models. We ran 600 gallons of water first through a sediment filler to remove coarse particles and then through the carbon filter. We checked periodically to see how much chloroform was being removed. All removed 100 percent of the chloroform at first, but the effectiveness of some units dropped off as they handled more water.

Even with our pre-filtration, the *Bionaire* and the *Everpure* units clogged with sediment before they could handle more than 300 gallons of water. Their flow rate had dropped to a virtual trickle. Both filters were removing all the chloroform when they quit. But because they clogged so rapidly, their useful life was short.

Most of the other high-volume filters were still removing at least 90 percent of the chloroform at the end of the test. Those that removed less released water with a chloroform level above the maximum mandated by the EPA. Among the three models

Best at removing: Bad taste, odors, chlorine, organic chemicals, pesticides.
May help with: Sediment, turbidity.
Not effective against: Microbial contamination, lead and other heavy metals, sodium, nitrate, fluoride, hardness minerals.

Carbon-filter mechanics High-volume filters: Water flows through a labyrinth of activated-carbon granules that trap and hold contaminants. The Ametek CCF-201 shown here uses two filter cartridges; most others use one. The Ametek also has a meter that shuts off the water when the cartridges are due to be changed. Faucet-mount filters: As water flows from the tap, it's channeled through a tiny carbon filter. The amount of carbon is too small to be very effective.

removing less than 90 percent of the chloroform at the end of the test was the highly touted *NSA*.

Faucet-mount models. These little filters are virtually useless at filtering out dangerous contaminants. They are so small that the carbon has little opportunity to do its job as water flows through them.

After handling 200 gallons of our chloroform-laced water, all the faucet-mount cartridges were overdue for a change. The best was removing only 60 percent of the chloroform; the worst, only 30 percent.

A faucet-mount filter might remove odors and off-tastes for a while, but don't depend on one to remove health-threatening substances.

One pitcher at a time

Pour-through carbon filters function much like a drip coffee maker. Pour water into the top of the container, and it drips through a carbon filter to yield a few quarts of drinking water.

Pour-through filters work slowly, making them something of a nuisance to use. Typically, the instructions tell you to keep them in the refrigerator, where bacteria are less apt to multiply.

According to the manufacturers, water-treating capacity ranges from 20 to 100 gallons between filter changes. The pitchers might be able to remove off-tastes from that much water. But our tests, using water laced with chloroform and phenol, suggest those claims are optimistic when it comes to removing organic contaminants. After processing 20 gallons, the best pour-through type was removing only slightly more than half the adulterants.

Time for a change

Unless you test your drinking water periodically, you won't be able to tell when a carbon filter is exhausted or sullied with bacteria. Toward the end of its life, the filter will clog, or you'll notice the reappearance of the off-tastes and odors that led you to buy the filter in the first place. But the filter may have long since lost its effectiveness against harmful organic chemicals.

You'll have to make an educated guess about when to change the filter cartridge. For the high-volume units, a change after six months or 1000 gallons has passed is a reasonable rule of thumb.

Some filters are designed to help you remember to change the cartridge before it's exhausted. The *Ametek* and the *Kinetico,* for example, have a commendable feature: a built-in meter that shuts down the unit after a preset amount of water has been processed.

The *Hurley II,* a model with a bed of carbon that's claimed to last for five years, can be back-flushed periodically with hot water. Don't depend on hot flushes. They will remove accumulations of sediment and algae, but they probably won't kill bacteria or loosen an appreciable amount of the organic chemicals trapped by the charcoal. The manufacturer will replace the carbon, for $56, if you return the filter.

Recommendations

If an analysis shows that your water is contaminated with organic chemicals, you should install a high-volume carbon filter. Don't rely on a faucet-mount or pour-through filter to solve the problem.

Of the high-volume filters we tested, four did an excellent job of removing contaminants in our tests. They are the *Ametek CCF-201* ($267 list, also sold as the *Sears 34201* for $158 plus shipping), the *Ecowater Water Master* ($250), the *Amway E-9230* ($276), and the *Hurley II* ($375). The *Ametek* is the best choice among the four. It has two carbon cartridges linked in series, and a built-in meter that cuts off the flow after 1500 gallons, impelling you to change the filter.

If your water isn't seriously contaminated, consider two low-priced units from the second Ratings group: The *Filterite CF 10,* $85, or the *Cuno AquaPure AP-CRF,* $117.

We strongly recommend installing a sediment filter ahead of any carbon filter, to cull out solids that could clog the carbon prematurely. The handiest sediment filters have a shut-off valve and a clear canister that lets you see quickly if the filter element needs to be changed. Available at plumbing-supply stores, a sediment filter should cost about $40, plus installation; replacement cartridges cost less than $10 apiece.

Installing a high-volume filter is a bit of a nuisance, but not beyond the reach of most do-it-yourselfers. In many cases, the only tool you'll need is a wrench. You won't have to cut the water pipes or solder anything together. You will have to drill a hole in the countertop for the filter's dispensing faucet or remove the sprayer hose from the sink and use that hole for the faucet. ■

Norelco Clean Water Machine

REFUNDS AVAILABLE

The last chapter in the saga of the *Norelco Clean Water Machine* is about to come to a close. We wrote the first chapter of the story in February 1983, when we reported that the *Clean Water Machine* was putting methylene chloride, a suspected human carcinogen, into the water it filtered. The company told us it knew of the problem and that cartridges with the chemical would soon be off the market.

But our follow-up tests three years later showed the same problem with methylene chloride. We advised readers to stop using the *Clean Water Machine* immediately, and petitioned the Food and Drug Administration for a recall of the devices. That prompted Norelco to institute a "replacement program." Owners of the *Clean Water Machine* could get new, nonpolluting cartridges free by sending their old ones back to Norelco.

Then, in 1988, a Federal Trade Commission judge found Norelco's parent, North American Philips, guilty of false advertising for the machine. Citing "blatant and utter disregard" for the law and consumer welfare, the judge said the company had claimed its machine made water cleaner even though it knew—because CU told it—that the machine added a suspected carcinogen to the water.

Two months later, a group of *Clean Water Machine* owners filed a class-action suit. Now, North American Philips has settled the suit and has agreed to set up a $2.5-million fund to repay people who bought the machine or filters for it.

If you bought a *Norelco Clean Water Machine* or replacement cartridges before 1989 and you want a refund, write for a claim form to:

Dianne M. Nast, Esq.
Lead Counsel for Plaintiff Class
Kohn, Savett, Klein & Graf, P.C.
1101 Market St., Suite 2400
Philadelphia, Pa. 19107

No proof of purchase is required, nor do claimants have to return the machine or the filters. The deadline for filing a claim is Feb. 15, 1990.

RATINGS

Carbon filters

Listed by types; within types, listed except as noted in groups according to their ability to remove chloroform from water in our tests. Within groups, listed in order of increasing price. In our judgment, faucet-mount and pour-through types should be used only for taste and odor problems, not to remove harmful impurities.

1 Price. The manufacturer's suggested retail price. + indicates shipping is extra. A * means price includes installation.

2 Cartridge cost. For some models, the cost of a new cartridge can be rather high. The (2) following some prices indicates a filter that requires a pair of cartridges; price given is for a package of two. A dash indicates a filter with a nonreplaceable cartridge.

3 Chloroform removal. Our key test of filter performance. We used water spiked with chloroform, a byproduct of chlorination that also indicates how well a filter can handle other organic compounds. A fresh carbon cartridge in a high-volume filter could remove all the chloroform, but some filters lost effectiveness over time. The bars in this column show the percentage of chloroform the filters could remove after handling a specified amount of water: 600 gallons for the high-volume filters, 200 gallons for the faucet-mount filters, and 20 gallons for the pour-through models. The best units removed all the chloroform we could measure (at least 96 percent). The chloroform concentration we used, 1 part per million, is 10 times the Government's allowable limit for drinking water. A filter would have to remove 90 percent of the chloroform in our tests to bring the water to acceptable levels.

4 Dimensions. The outside dimensions of the systems (exclusive of plumbing). Some could be a tight fit inside a sink cabinet.

5 Standard cartridge? A check indicates a filter that will accept any cartridge measuring 9¾ inches high and 2½ to 3 inches in diameter. The others must be refilled with a cartridge from the filter maker.

Brand and model	1 Price	2 Cartridge cost	3 Chloroform removal (0 20 40 60 80 100)	4 Dimensions, HxWxD or Hx dia., in.	5 Standard cartridge	Comments
High-volume filters						
Ametek CCF-201	$158+	$20 (2)		16x12x5½	✔	F,S
Ecowater Water Master	250	33 (2)		14x16x5½	✔	R
Amway E-9230	276	69		13½x7	—	D,J,Q
Hurley II	375	—		11x6½x9	—	A,G,H,K,L
Filterite CF 10	85	8		13½x7½x4	✔	C,E
Cuno AquaPure AP-CRF	155	15		14x5x7	—	—
Kinetico MAC	275	32		13x7x5	—	F
Culligan SuperGard THM	349*	37		17x5x7	—	H,P
Teledyne Instapure IF-10	50	12		15x7x5	✔	C,E,I
Omni UC-2	99	20 (2)		16x13x6	✔	E
NSA Bacteriostatic 50C	179	—		11x4x6	—	G
■ *The following models were downrated because they clogged after filtering only 300 gallons.*						
Bionaire H20 BT850	199	100		14½x6½x6	—	B,J,Q
Everpure H200	298	90		18½x4x4½	—	B
Faucet-mount filters						
Cuno Purity PP01105	30	6		5½x2½x6	—	B
Teledyne Instapure F-2C	24	5		4½x2½x5	—	I
Pollenex WP90K	22	5		5x3x5½	—	I
Pour-through filters						
Brita	30	8		9½x7x9	—	O
Innova	7	5		10x4x6	—	N
Glacier Pure	13	5		8½x6½x13½	—	M

Specifications and Features
Except as noted, all: • High-volume models are designed for installation under sink cabinet. • High-volume models have fittings for use with ¼-in. or ⅜-in. dia. tubing. • Have replaceable granular-activated-carbon cartridge. • High-volume models come with faucet.

Key to Comments
A–Flow rate almost twice that of any other model tested; uses ½-in. dia. tubing.
B–Flow rate decreases gradually with use to below minimum useful level because filter clogs.
C–Not supplied with faucet; intended to be installed in the cold-water line.
D–Can be installed as countertop unit with adapter. Price paid includes optional faucet, $76.
E–Filter housing can be used with ¾ in. dia. threaded pipe.
F–**Ametek** has built-in water meter that shuts off after 1500 gal.; **Kinetico** has built-in water meter that shuts off after 600 gal. Only **Ametek** meter can be reset without replacing cartridge.
G–Designed to sit on countertop.
H–Has stainless-steel housing.
I–Has transparent filter housing, which allows you to see condition of cartridge; an advantage.
J–Cartridge more difficult to replace than most.
K–According to mfr., filter life can be extended by backwashing with 140°F water.
L–Mfr. recommends return of unit for fresh carbon every 5 yr., at a cost of $56.
M–Container volume, 4 qt.
N–Container volume, 3 qt.
O–Container volume, 2 qt.
P–Price paid includes optional faucet ($75 with dealer installation).
Q–Filter cartridge is of carbon block type.
R–First filter is carbon block, second is granular.
S–Bought as **Sears 34201** for price shown. **Ametek**'s list price, $267.

REVERSE-OSMOSIS SYSTEMS: SLOW BUT EFFECTIVE

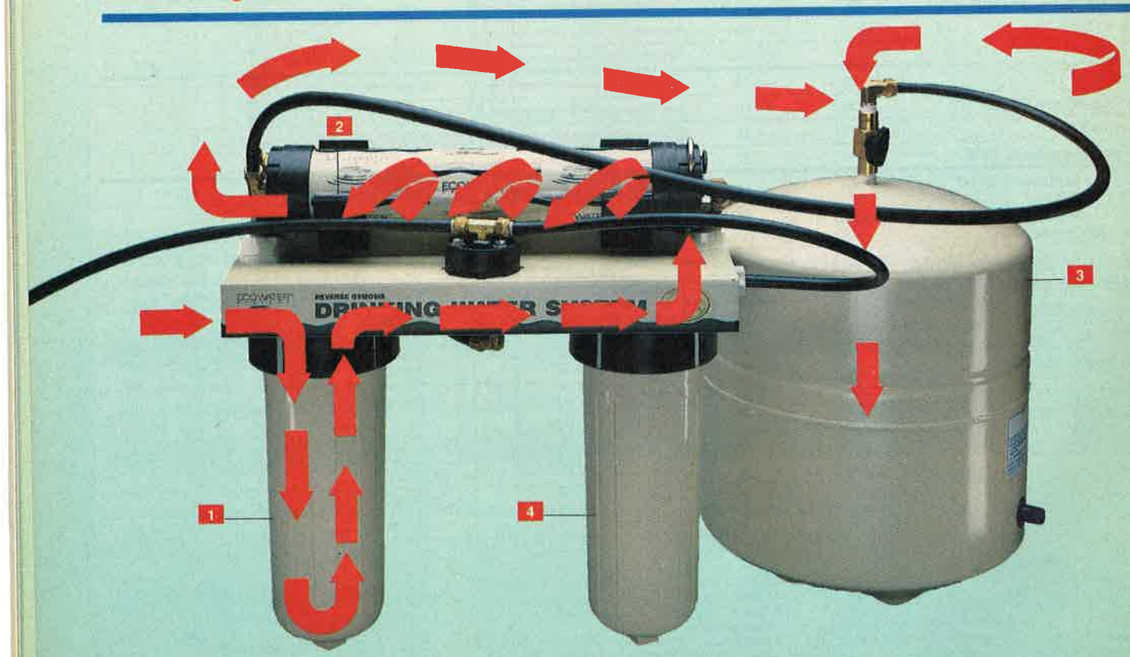
If a carbon filter resembles a labyrinthine trap for contaminants in water, a reverse-osmosis system resembles a sieve. The water isn't strained in the usual sense. Instead, ions (charged particles) and large molecules are excluded; water and small organic molecules pass through. Pressure in the water line does the work, pushing the water against a cellophanelike plastic sheet known as a semipermeable membrane.

Reverse osmosis removes salt and most other inorganic material present in the water. For that reason, reverse osmosis lends itself to use not only in places where the drinking water is brackish, but also where it's loaded with heavy metals, nitrate, or fluoride. (Reverse osmosis has been used for several years in plants on the Persian Gulf and the Florida coast to remove salt from sea water.)

The reverse-osmosis systems available for home use make limited amounts of water for drinking or cooking—a few gallons a day at the most. Some waste a fair amount of water in the bargain.

The 16 systems we tested—typically, a package consisting of a sediment filter, the reverse-osmosis membrane, a storage tank, and an activated-carbon filter—range in price from $61 to $850. That wide range reflects differences in capacity and in complexity of design. Five tested models fit on a countertop; the others can be installed under a sink.

Best at removing: Inorganic contaminants, such as dissolved salts of sodium, ferrous iron, fluoride, nitrate, lead; organic contaminants.
Not effective against: High levels of hardness minerals.



Reverse-osmosis mechanics Arrows trace the water's path. It passes first through a sediment filter 1, which culls coarse solids that could plug up the reverse-osmosis membrane. Water next follows the spiral winding of the membrane 2. Contaminated water leaves the system and goes down the drain; treated water moves on to a holding tank 3. When you draw water from the tank, it flows through a carbon filter 4 to remove organic chemicals, then out a spigot.

Putting on the squeeze

We tested the reverse-osmosis devices using water laden with 600 parts per million of sodium chloride (a representative dissolved solid), and 2 to 10 times the Government's allowable limits for lead, cadmium, copper, and barium. We also measured the removal of calcium, a hardness mineral present in moderate amounts in our local supply.

To challenge the filters further, we pumped our test water at an average of 45 pounds per square inch (psi), close to the minimum operating pressure needed for a reverse-osmosis system. (Most units we tested specify a minimum pressure of 40 psi.)

Most units did a fine job of removing the salt from our water. The best removed more than 95 percent. The units also removed toxic metals impressively well. In the case of lead, the metal with the greatest potential for harm, all but the *Ametek RO-2000* reduced the level from 128 parts per billion (ppb) to less than 10 ppb, about the lowest level we could detect. The *Ametek* reduced the lead contamination to about 23 ppb—roughly half the current Government limit of 50 ppb, but much higher than the new limit of 10 ppb the Environmental Protection Agency is expected to mandate later this year.

Every unit except the *Sears* countertop model removed virtually all the other heavy metals we could measure. The *Sears* eliminated at least 90 percent.

Most reverse-osmosis units could handle the small amount of calcium in our water. Calcium can hinder the working of the reverse-osmosis membrane by clogging its pores. Indeed, several manufacturers advise against using a reverse-osmosis system if the calcium level exceeds 10 grains of hardness per gallon. Our water had 1 grain per gallon, and all the units except the *Ametek* and *Cuno* under-cabinet models removed at least 80 percent of the calcium.

The systems we tested also removed organic contaminants from the water—thanks mostly to the carbon filter that's part of the system.

Down the drain

Sales literature for reverse-osmosis systems rarely points out that they waste a lot of water. Only 10 to 25 percent of the water passing through the unit is forced through the membrane. The rest goes down the drain.

As the Ratings indicate, most units waste 13 gallons or more each day. The most profligate—the *Filterite* under-sink unit—wastes close to 40 gallons a day, almost 14,000 gallons per year.

Several under-sink models run all the time, even when their tank is full. Those models, noted in the Ratings, waste water every day even if you aren't using them.

A watched pot

Reverse osmosis is a slow process. The under-sink units we tested generally needed three to six hours to process one gallon of drinking water. The countertop units were even slower—four hours per gallon for the fastest, 21 hours for the slowest.

To keep a ready supply of water at hand, all the under-sink systems incorporate a two-gallon holding tank for the processed water, with a separate spigot installed next to the sink.

Countertop models, which have a hose that snaps onto the end of the sink faucet, need no special installation. Some come with a reservoir or jug that collects the filtered water. Other models require you to supply your own container; you put it in the sink and let the reverse-osmosis unit fill it. Then you can keep the water in the refrigerator.

Which membrane?

The reverse-osmosis membrane is made either from thin-film composite (TFC, in the trade) or cellulose triacetate (CTA). TFC does a faster, more efficient job, but degrades in the presence of chlorine. The cellulose type is considerably cheaper and holds up well in chlorinated water.

TFC can be used with chlorinated water as long as it's preceded by a carbon filter to remove the chlorine. Only two makers supplied TFC membranes for use with chlorinated water, but they were the best in our tests.

As the Ratings indicate, a CTA cartridge costs $45 to $130 to replace. A TFC cartridge costs $108 to $234. You'll also need to spend another $25 or so to replace the sediment and carbon filters in most systems when you change the membrane. If you use two gallons of water a day, you'd normally change the cartridges about once a year. So annual upkeep on a reverse-osmosis system ranges from 10 to 36 cents per gallon.

Recommendations

A reverse-osmosis system makes sense only for people who have unacceptably high levels of dissolved solids, lead, or other inorganic contaminants in their drinking water—and who can justify wasting lots of water for the sake of a few gallons of clean drinking water.

Check-rated
Culligan Aqua-Cleer Compact, $499 list.

Almost all the units we tested were quite effective at removing toxic metals. The main differences are speed (some produce little more than a gallon of water a day), water waste, and price. We've check-rated the *Culligan Aqua Cleer Compact*, a countertop unit, because it's elegantly simple, very effective, and reasonably priced. It lists for $499, installed, but we paid only $284 for our sample.

The best under-sink units—the *Culligan Aqua-Cleer* ($849, installed) and the *Everpure Ultimate 1* ($740)—not only removed metals but also sieved out nearly all the dissolved solids we had injected into the water. Those two can also process more water than the others—up to eight gallons a day. The main drawbacks with any under-sink unit: The bulky holding tank can be hard to fit in a sink cabinet, and the water in the tank stays at room temperature. ■

Turn page for Ratings

SPECIAL FILTERS

GET THE LEAD OUT

The reverse-osmosis units in the accompanying report can remove lead from water quite effectively. But an expensive reverse-osmosis system isn't the only way to cut lead levels.

We tested two filter cartridges designed specifically to remove lead. The better of the two, the *Selecto Lead Out-20*, is a cheaper solution if lead is the only problem with your water.

The *Selecto* costs $80 and fits a standard filter housing. It uses activated alumina and claims to treat 15,000 gallons of water. We couldn't test its longevity, but we did find it quite effective in the short term. The water we used contained 133 parts per billion of lead. The *Selecto* cut that level to below 10 ppb—below the limit the Government is expected to set later this year.

The other filter, the *Matt-Son SOT-10*, $50, works on the same principle as a water softener. It, too, fits a standard filter housing, and it is claimed to last for 1000 gallons or six months. But it cut the lead in our spiked water only down to 30 ppb. And because it works like a softener, it will also pick up other minerals, shortening its useful life as a lead-remover. Further, the samples we tested were poorly made.